SECTION 4 - EQUIVALENT PROCEDURES FOR PROPELLER DRIVEN AEROPLANES NOT EXCEEDING 9000 kg

The following procedures have been used as equivalent in stringency to Chapter 6 and Chapter 10 of Annex 16, Volume 1 for propeller-driven aeroplanes with maximum certificated take-off mass not exceeding 9000 kg.

4.1 SOURCE NOISE ADJUSTMENTS

Source noise adjustment data for propeller driven light aeroplanes may be established by flying the test aeroplane with a range of propeller speeds (for fixed propellers) and torque or manifold air pressure (MAP) values (for variable pitch propellers).

4.1.1 Fixed pitch propellers

For aeroplanes fitted with fixed pitch propellers source noise sensitivity curves are developed from data taken by measuring the noise level for the aeroplane flying at 300 m (985 ft) as described in paragraph 6.5.2 of Annex 16, Volume 1 at the propeller speed for maximum continuous power N_{MCP}. Aeroplanes demonstrating compliance with Annex 16, Chapter 10, should be flown according to paragraph 2.3 of Appendix 6 of Annex 16, Volume 1 such that the aircraft overflys the microphone at the reference height H_{REF} (defined in paragraph 5.1 of Appendix 6), the best rate of climb speed V_y and at the propeller speed, N_{MAX}, corresponding to that defined in paragraph d) of *Second Phase* of paragraph 10.5.2 of Annex 16. Noise measurements are repeated at two lower propeller speeds typically 200 rpm and 400 rpm lower than N_{MCP} or N_{MAX}. For Chapter 10 aeroplanes these should be flown at speed V_y. The maximum A-weighted noise peak noise level (L_{Amax}) is plotted against propeller helical tip Mach number (M_H) to obtain the curve from which the source noise correction may be derived.

For fixed pitch propellers it is generally not possible via flight tests to separate out the two significant noise generating parameters, helical tip Mach number and power absorbed by the propeller. A sensitivity curve of Mach number versus noise level derived from flight tests of a fixed pitch propeller (either level flyovers or fixed speed climbs) will therefore include within it the effects not only of Mach number but also power. Under these circumstances it is not appropriate to apply a separate power correction.

4.1.2 Variable pitch propellers

4.1.2.1 For variable pitch propellers the data is taken with the aircraft flying over a range of propeller speeds, typically three, at a fixed torque or MAP in a manner similar to that described in 4.1.1 where N_{MCP} or N_{MAX} would, in this case, be the maximum propeller speed at the maximum permitted torque or MAP. This is repeated for two lower torque or MAP values to establish a carpet plot of maximum A-weighted noise levels against propeller speed and torque, MAP or shaft horse power (SHP).

4.1.2.2 A plot of maximum A-weighted noise level (L_{Amax}), helical tip Mach number (M_H) and torque or MAP is developed which is used to derive the source noise adjustment (L_{Amax}) being the difference between reference and test conditions at the noise certification power.

4.1.2.3 Generally the test and reference engine SHP can be derived from the engine manufacturer's performance curves. However, where such curves are not available a correction should be applied to the manufacturer's published engine SHP (normally presented for a range of engine speeds under ISA and sea level conditions) to establish the engine power level under the test conditions of ambient temperature and air density, as follows:

$$P_T = P_R\left[\left(T_R / T_T\right)^{1/2}\right]\left[\left(s - 0.117\right) / 0.883\right]$$, for normally aspirated engines;

and

$$P_T = P_R\left[\left(T_R / T_T\right)^{1/2}\right]$$, for turbo-charged engines,

where P_T and P_R are the test and reference engine powers, T_T and T_R are the test and reference ambient temperatures, and σ is the air density ratio. Note that in this context *reference* denotes the reference conditions for which the engine SHP is known.

4.2 TAKE-OFF TEST AND REFERENCE PROCEDURES

In planning a test programme for noise certification under Chapter 10 and Appendix 6, it is helpful to note the differences between test day flight procedures and the standardised take-off reference profile.

4.2.1 The take-off reference profile is used to compute the altitude and speed of the aircraft passing over the microphone on a standard day. The requirements for this profile are contained in paragraph 10.5.2 of Chapter 10. They require that the first segment be computed, using airworthiness approved data, assuming take-off power is used from the brake release point to 15 m (50 feet) above the runway. The second segment is assumed to begin precisely at the end of the first segment, with the aeroplane in a climb configuration (gear up and climb flaps) and operating at the certificated speed for best rate of climb V_y.

A worked example of the calculation of reference flyover height and reference conditions for correction of source noise for aeroplanes certificated according to the standards of Annex 16, Chapter 10 is presented in Appendix (5) of this manual.

4.2.2 Requirements for aeroplane test procedures are contained in two places: Section 10.6 of Chapter 10 and Section 2.3 of Appendix 6. They basically only speak to test tolerances and approval of test plans by certificating authorities.

4.2.3 Figure 13 illustrates the difference between the two. Note that the actual flight test path need not include a complete take-off from a standing condition. Rather, it assumes that a flight path intercept technique is used. As with the turbojet and helicopter standards, the aeroplanes would be flown to intersect the second phase (segment) climb path at the right speed and angle of climb when going over the microphone within 20 per cent of the reference height.